FERC-0065

PLANNING STATUS REPORT

WATER RESOURCES APPRAISALS
FOR HYDROELECTRIC LICENSING

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GRAND RIVER BASIN

MICHIGAN

FEDERAL ENERGY REGULATORY COMMISSION
OFFICE OF ELECTRIC POWER REGULATION
CHICAGO REGIONAL OFFICE

Revised November 1980

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FERC-0065

PLANNING STATUS REPORT

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING

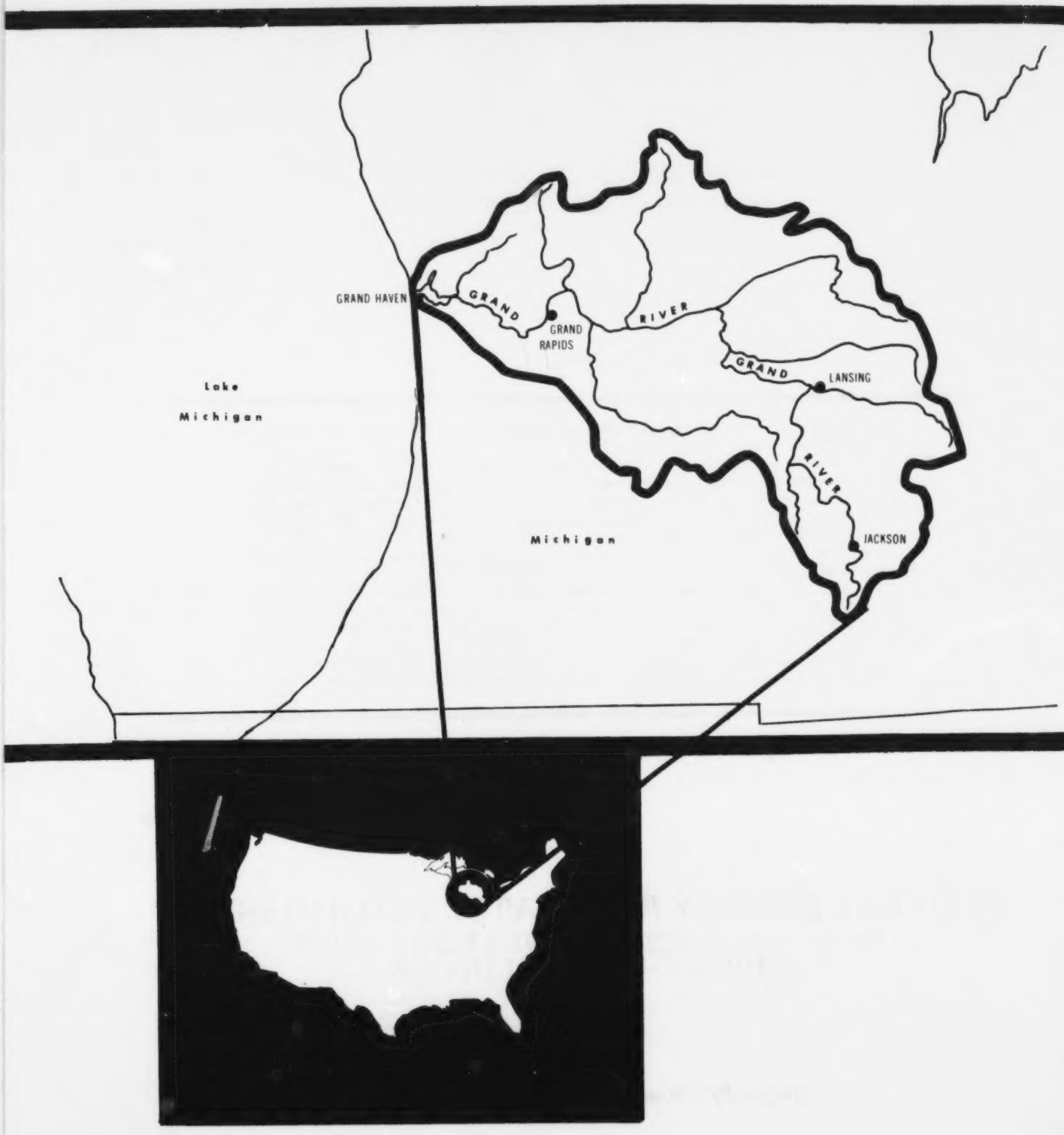
This is one of a series of revised Planning Status Reports for major river basins in the United States. The original reports, which were prepared several years ago, are being revised as part of a program of Water Resources Appraisals for Hydroelectric Licensing. The revised reports provide updated information on water resources for use by the Federal Energy Regulatory Commission and its staff when considering hydroelectric licensing and other work. The reports present data on water resource developments, existing and potential, and on water use by existing and projected steam-electric generating facilities. The reports also summarize past and current planning studies. The information presented in these reports was abstracted from available sources and involved no new analyses. Information is current as of July 1980 unless otherwise indicated. The report is a staff effort which was not prepared for adoption or approval by the Commission, and does not commit or prejudice later Commission action. Although others contributed to the preparation, the primary author was Witold Pawlikowski in the Chicago Regional Office.

FEDERAL ENERGY REGULATORY COMMISSION
OFFICE OF ELECTRIC POWER REGULATION
CHICAGO REGIONAL OFFICE

Originally Issued 1965-Revised 1980

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

THE GRAND RIVER BASIN



DESCRIPTION OF THE BASIN

The Grand River basin is located in the southern half of the Lower Peninsula of the State of Michigan. The 135-mile long and 70-mile wide oval-shaped basin has a drainage area of 5,572 square miles which is about 10 percent of the land area of Michigan. The Grand River itself is over 260 miles long and drops 460 feet before discharging into Lake Michigan. Most flood plains of the Grand River and the major tributaries are broad and have only a few feet of water flowing in their channels. The basin's rivers generally remain within their banks but the river valley has flooded to widths of 4,000 feet downstream of Grand Rapids and Ionia.

The Grand River basin has six major tributaries. The Rogue (255 square miles), Flat (550 square miles), and the Maple (970 square miles) Rivers enter from the north. The Thornapple (875 square miles) enters from the south, and the Looking Glass (290 square miles) and Red Cedar (472 square miles) Rivers enter from the east. The drainage area of these tributaries comprises about 60 percent of the total drainage area of the basin. A stream profile, figure 1, and a detailed basin map, figure 2, are included at the end of this report.

The annual precipitation for the basin ranges from 25 to 32 inches. Precipitation is relatively uniform over the area; however, the annual snowfall varies from a negligible amount to several feet. Runoff is about 25 percent of the annual precipitation. The runoff yields an average streamflow of about 3,400 cubic feet per second at Grand Rapids, where runoff comes from 88 percent of the basin's drainage area.

The average summer temperature in the basin is about 74 degrees and the average winter temperature is about 22 degrees with seasonal extremes of 105 to -25 degrees Fahrenheit.

Lansing, the State capitol, houses numerous governmental agencies. Michigan State University, which is located in East Lansing, works closely with State and Federal agencies in developing the agricultural and highway programs. Grand Valley State College is also located in the basin near Eastmanville.

An estimated 1980 population of approximately 1.5 million in the Grand River basin makes up 14 percent of the State's population. Nearly 63 percent of the basin's population is urban and is concentrated around Jackson, Lansing, and Grand Rapids. The rapid population growth of the recent past is expected to continue.

The dominant economic factors in the basin are industry, agriculture, government, education, and mineral resources. The cities of Grand Rapids, Lansing, and Jackson contain light and heavy industries that contribute significantly to the economy of both the State of Michigan and the Nation. Grand Rapids and Lansing are noted primarily for their automobile manufacturing plants. However, the manufacturers of furniture, textiles, hardware, dairy products, and paper are also located in the basin. Other industries include metal plating and meat packing. The basin also produces natural gas, oil, salt, brine, brick, tile, limestone, cement, marsh peat, and large quantities of sand and gravel.

About 8 percent of the land is urbanized, while most of the 3.6 million acres are in agricultural and forest uses. Dairy and general farming, together with specialty crops in local areas, comprise the principal agricultural uses.

DESCRIPTION OF THE BASIN

In the vicinity of Lansing, the Grand River receives substantial wastewater flows from industrial, municipal, and combined storm-sanitary sources. Biological data from 3 years, 1974-1976, indicate a continuing and consistent degradation of water quality downstream from Lansing. The Lansing Wastewater Treatment Plant began tertiary treatment in February 1977. The wastewater effluent quality should improve considerably as these treatment works begin to operate. The quality of the untreated storm water will, however, have a detrimental effect on the overall quality of the area's surface waters.

The basin experiences heavy demands for fishing, hunting, and other types of recreation. Many of the small lakes scattered throughout the basin have been developed for recreational use by private enterprise and the Lake Michigan shoreline at the western end of the basin is widely used for recreation. In general, there have not been adequate recreational facilities available in the basin and many residents are seeking facilities outside the basin. There is a need for development of water resources for recreational use, especially in the Lansing and Northeast areas.

There are no wild and scenic rivers or wilderness areas in the Grand River basin, and no studies for such designations are underway.

The chief sources of water supply for industry and agriculture are wells, the Grand River, and Lake Michigan. A few inland lakes are also used to supply relatively small areas. Obtaining sufficient quantities of water of an acceptable quality is a growing problem. All the cities in the basin obtain their supply from underground sources with the exception of Grand Rapids which receives its water from Lake Michigan. A few industrial units use readily available surface water; however, most industrial water supply comes from groundwater. The combination of industrial and municipal uses of underground water in the basin has caused the water tables to recede and the underground reserves are being seriously depleted in some areas.

Groundwater resources are utilized by nearly all communities, industries, farmers, and rural residents as their source of water supply. The basin's aquifers can be separated into two broad groups, the glacial aquifers and the bedrock aquifers. Most large-diameter wells tapping glacial aquifers yield 300 to 500 gallons per minute, and those tapping bedrock aquifers may yield 300 to 1,000 gallons per minute.

Irrigation in the basin takes place on some 21,000 acres and utilizes 11,000 acre-feet of water annually. Water sources are about evenly split between groundwater and surface water.

EXISTING WATER RESOURCE DEVELOPMENTS

The seven hydroelectric developments with a combined installed capacity of 6,134 are shown in table 1. Table 2 lists the retired hydroelectric projects in the basin. The total capacity of these projects is about 12,000 kilowatts.

Presently, there are four fossil-fueled steam-electric plants located in the Grand River basin, with a total generating capacity of 648,000 kilowatts. Pertinent data for these plants are shown in table 3.

EXISTING WATER RESOURCE DEVELOPMENTS

Table 1

Existing Hydroelectric Projects
Grand River Basin

Map No.	Project Name	River	Owner Class 1/	Owner	Drainage Area (sq mi)	Gross Head (ft)	Installed Capacity (kw)	Average Annual Generation (MWh)	Initial Operation Year
1	Webber	Grand	U	Consumers Power Co.	1,751	26	3,250	9,100	1907
2	Portland	Grand	P	Portland Electric Dept.	1,695	20	375	2,400	1930
3	North Lansing	Grand	P	Lansing Water & Light Commission	1,230	9	200	1,110	1936
4	Moores Park	Grand	P	Lansing Water & Light Commission	758	15	1,000	2,600	1907
5	Smithville	Grand	P	Grand River Power Co. Inc.	570	13	500	2/	1936
6	Irving	Thornapple	U	Mid State Service Co.	2/	7	600	2,100	1939
7	Eaton Rapids	Spring Brook	P	Grand River Power Co.	655	9	209	2/	1936
						Total	6,134		

1/ *U-privately-owned utility; P-non-Federal publicly-owned utility.*
2/ *Not available.*

Table 2

Retired Hydroelectric Projects
Grand River Basin

Map No.	Project Name	Stream	Last Owner	Drainage Area (sq mi)	Gross Head (ft)	Installed Capacity (kW)	Year Retired
8	Childsdale	Rogue	H.H. Childs	250	16	21	1/
9	Rockford	Rogue	H.H. Childs	245	14	100	1/
10	Ada	Thornapple	Consumers Power Co.	875	22	2,000	1970
11	Cascade	Thornapple	Consumers Power Co.	813	28	2,560	1971
13	Middleville	Thornapple	Mid State Service Co.	1/	12	350	1/
14	Kingmill	Flat	King Milling Co.	1/	1/	170	1/
15	Lowell No. 1	Flat	Consumers Power Co.	540	34	900	1965
16	Smyrna	Flat	Consumers Power Co.	500	8	200	1/
17	Belding	Flat	Consumers Power Co.	500	10	485	1962
18	Greenville	Flat	Consumers Power Co.	455	1/	300	1950
19	Sarnac Mill Pond	Lake Creek	T.P. Rowen	23	13	75	1/
20	Hubbardston	Fish Creek	Consumers Power Co.	185	20	320	1/
21	Elsie	Maple	Floyd W. Bouek	220	7	60	1/
22	Lyons	Grand	Consumers Power Co.	1,735	10	440	1/
23	WaCousta	Looking Glass	A.W. Sherman	250	12	40	1/
24	Williamston	Red Cedar	Stewart & Pfeiffle	232	10	112	1/
25	Dimondale	Grand	City of Lansing	715	8	1/	1/
26	Jackson	Grand	Thorrez & Maez Mfg.	130	8	529	1946
27	Michigan Center	Michigan Center Creek	City of Jackson	55	7	1/	1/
28	Liberty Mills	Grand	B.F. Loomis	13	16	94	1/
	Wagar 2/	Grand	Consumers Power Co.	1/	10	375	1/
	Lowell 2/	Flat	Village of Lowell	1/	19	630	197
	Maple River 2/	Maple	Consumers Power Co.	1/	17	192	195
	Pellston 2/	Maple	Michigan Public Service Co.	1/	1/	270	1/
	Portland 2/	Looking Glass	Valley City Milling	1/	7	112	1/
	Henry Ford River 2/	Rogue	Univ. of Michigan at Dearborn	1/	8	110	1951
33	Grand Rapids	Grand	Consumers Power Co.	1/	17	400	1960
41	LaBarge	Thornapple	Consumers Power Co.	776	19	700	1965

1/ *Not available.*
2/ *Not shown on basin map and profile.*

EXISTING WATER RESOURCE DEVELOPMENTS

Table 3

Existing Steam-Electric Plants
Grand River Basin

Map No.	Plant Name	Owner 1/	Capacity (kW)	Generation 1975 (GWh)	Type Cooling 2/	Source	Cooling Water Use Withdrawn (mgd)	Cooling Water Use Consumed (mgd)
29	Island	GRHA	20,000	133 3/	OT	Grand River	46.3	--
30	Eckert Sta.	LABW	386,000	831	OT/CT	Grand River	87.0	1.0
31	Erickson	LABW	160,000	929	CT	Wells	3.0	2.0
32	Ottawa	LABW	82,000	40	OT	Grand River	4.0	0.0

1/ GRHA-City of Grand Haven, Board of Light & Power; LABW-Lansing Board of Water & Light.
2/ OT-once-through; CT-cooling tower, wet; OT/CT-75 percent once-through, 25 percent cooling tower, wet.
3/ Generation in 1977.

The Corps of Engineers maintains a navigation harbor at Grand Haven. The commercial facilities are located mostly at the City of Ferrysburg. The harbor facilities have been improved by the Corps of Engineers by dredging a wide, deep channel, and constructing protective piers and revetments. The harbor depth is 21 feet and the channel width is 300 feet. Commerce for the year 1976 totaled 830,900 tons and for the 5-year period 1972-1976 averaged about 1,933,300 tons. In addition to the commercial facilities, many marinas and boat clubs are located in this area. A shallow-draft channel 8 feet deep and 100 feet wide extends about 15 miles up the Grand River and makes a good waterway for commercial and recreational boating. The total cost of improvements as of September 1977 was almost $2,000,000.

Following the flood of March 1904, the Cities of Grand Rapids and Lansing expended monies for channel improvements and to construct flood retaining walls, levees, and concrete conduits. These improvements still protect these communities. No Federal flood control projects have been constructed in the Grand River basin. Potential flood control reservoirs are discussed elsewhere in this report.

STATUS OF HYDROELECTRIC LICENSING

The Webber Project No. 2566, owned by the Consumers Power Company, is the only project in the Grand River basin for which a major license application has been filed. The date of filing was January 6, 1966, and two supplements were filed, one on August 29, 1977 and the other on April 23, 1979.

The project is located on the Grand River in Ionia County, about 5 miles north of the town of Portland, Michigan. The project consists of a dam about 32 feet high and 1,200 feet long, and a 660-acre reservoir. The dam consists of (1) two earth embankment sections with a total length of 730 feet; (2) a 313-foot-long reinforced concrete spillway comprised of two Tainter gate sections and a needle beam section; and (3) a powerhouse section about 157 feet long. The powerhouse contains two generating units, one of which is rated at 2,250 kilowatts and the other at 1,000 kilowatts for a total installed capacity of 3,250 kilowatts. The project was constructed during the 1906-1907 period and placed in operation in March 1907.

Prior Studies and Reports

Prior Studies

House Documents No. 80, 73rd Congress, 1st Session, 1933, is the "308" Report prepared by the Corps of Engineers on the Grand River basin. This report recommended no additional improvements of the river for navigation either alone or in conjunction with power development, flood control or irrigation, or any combination thereof.

A 1950 report on Lansing, published as Senate Document No. 132, 84th Congress, 2d Session, followed a request by local interests for flood protection after the floods of 1947 and 1948. It recommended a plan of protection consisting of a diversion channel and channel improvements in the Lansing area. The project was authorized by the 84th Congress.

The Corps of Engineers, with the guidance of a coordinating committee representing the water resource agencies of the State and the Federal governments has published a comprehensive water resources study of the Grand River basin to determine the nature and extent of existing and projected water needs of the basin. This study formulates a basin-wide plan for developing water and related resources to meet these needs.

The Water Resources Planning Act of 1965 (P.L. 89-80) authorizes the Water Resources Council to maintain a continuing study of the Nation's water and related land resources and to prepare periodic assessments to determine the adequacy of these resources to meet present and future water requirements. The Council reported its first national assessment in 1968, which put into nationwide perspective estimates of present and future regional water and related land requirements and supplies. The Second National Water Assessment, published by the Council in December 1978, presents nationally consistent current and projected water use and supply information by regions and subregions for the United States. The second assessment found that significant achievements have been made in the past decade in preserving water and harnessing its power with a growing interest in water conservation and environmental protection; and that greater efforts are needed to insure careful management of our water resources and to solve the complex water and related land problems which still exist. A supplemental report to the second assessment, Water for Energy, provides information on energy and related water requirements at the region and subregion level for the years 1975, 1985, and 2000, including cooling water requirements for steam-electric generation.

Current Studies

Under the Water Resources Act of 1976, the Secretary of the Army, acting through the Chief of Engineers, is carrying out a demonstration program for assessing the adverse and beneficial impacts which may result from increasing Lake Michigan diversions at Chicago from 3,200 cubic feet per second to 10,000 cubic feet per second. The program is scheduled for completion in 1981.

A Great Lakes and St. Lawrence Seaway Navigation Season Extension Study was undertaken to determine the feasibility of extending navigation year round. A demonstration program has been initiated.

WATER RESOURCES PLANNING

Because of the great amount of navigation on the Great Lakes, the Corps of Engineers is presently engaged in a number of channel and harbor improvement studies. These studies consider the advisability of improvements for small craft, general navigation improvements such as enlargement of turning basins and deepening of channels, and the need for control of the Great Lakes water levels. The Corps of Engineers also has studies underway for local flood protection projects.

A Great Lakes Basin Framework Study was begun in 1967 under the aegis of the Great Lakes Basin Commission to develop an information base and to prepare components for a future comprehensive, coordinated, joint plan (CCJP) for the conservation, use, and development of water and land resources in the Great Lakes area through the year 2020. The CCJP (Regional Plan) was required by the Water Resources Planning Act (P.L. 89-80) and is a basic component of the National Planning Strategy being developed by the U.S. Water Resources Council. The Commission membership is comprised of representatives of State and Federal agencies involved with planning of water resources development within the basin. The Framework Study consisting of Level A, B, and C studies is the basis for the CCJP which is to be prepared for the U.S. Water Resources Council as required by P.L. 89-80.

Level A of the Framework Study which is the first and broadest level, evaluated and appraised on a broad basis, the needs and desires of the people for the conservation, development and utilization of water and related land resources and identified regions (hydrologic, political, economic, etc.) with complex problems which require more detailed investigations and analyses. This study, published in 1976, did not involve basic data collection, cost estimating, or detailed plan formulation. The Level B study, which is now being done, is a preliminary and reconnaissance water and related land plan for a selected area or river basin. Level C studies will be done in the future and consists primarily of specific project of program feasibility studies in the river basins or regions.

POTENTIAL WATER RESOURCE DEVELOPMENTS

Potential Hydroelectric Developments

There are four potential hydroelectric power sites in the basin that could be developed if found to be economically feasible. Also, the power installation at the existing Portland powerplant could be increased. The potential hydroelectric power developments would add about 18,700 kilowatts to the existing capacity of the basin and about 78,400,000 kilowatt-hours to the annual energy. The locations of the potential sites are shown on the basin profile, figure 1, and basin map, figure 2. A summary of data for the sites is included in table 4.

In addition to the potential hydroelectric developments shown in table 4, hydroelectric power development potential exists at the retired projects listed in table 2 where power was generated in the past.

The Grand River basin is currently an importer of electric energy, and is expected to continue to import in the future. The amount of possible future hydroelectric supply constitutes only a small portion of the total needs of the basin. Projects considered potential are not necessarily economically feasible and would have to be investigated as to their cost of development, size of plant feasible at each site, transmission required, potential value of energy produced, etc., when specific projects are formulated.

POTENTIAL WATER RESOURCE DEVELOPMENTS

Table 4

Potential Hydroelectric Developments
Grand River Basin

Map No.	Project Name	River	Drainage Area (sq mi)	Gross Head (ft)	Capacity (kW)	Average Annual Energy (MWh)
33	Grand Rapids	Grand	4,900	17	6,700	30,000
34	Saranac	Grand	2,980	16	3,700	16,700
35	Portland 1/	Grand	1,695	20	2,400	5,400
36	McGee	Grand	1,395	32	3,300	14,200
37	Danby	Grand	1,325	32	2,600	12,100

1/ Redevelopment of existing site.

Potential Flood Control Reservoirs

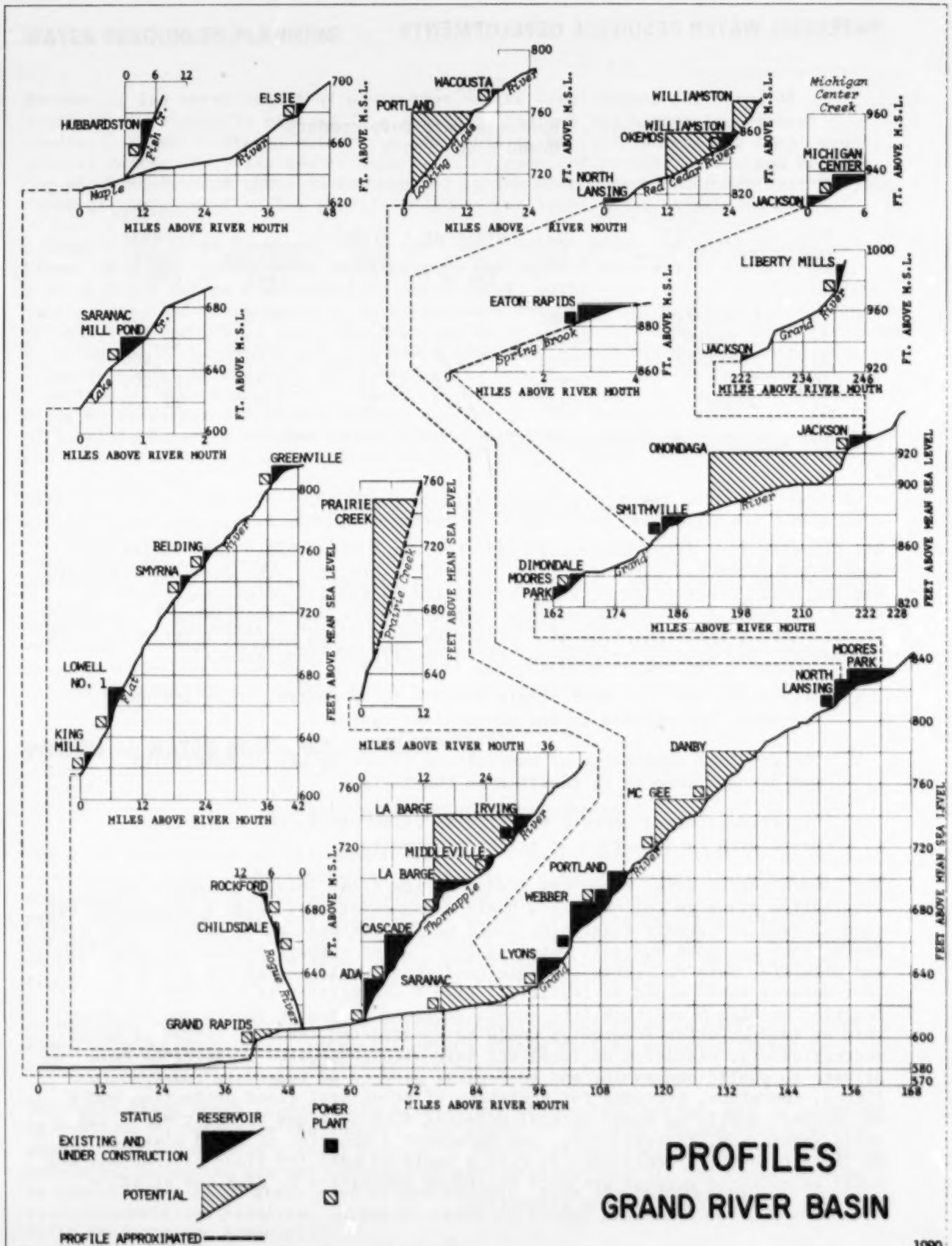
The Comprehensive Water Resources Study for Grand River basin has extensively researched potential sites for flood control reservoirs. The Corps of Engineers and the Soil Conservation Service inventoried 79 and 132 potential reservoir sites, respectively. An extensive screening process was established to determine feasibility of implementation of a single-purpose flood control reservoir within the basin. The studies pointed out three significant conclusions:

a) Reservoirs built to meet single-purpose flood control needs are not economically feasible in the Grand River basin.

b) The physical capability of controlling floods by use of reservoirs was demonstrated to be feasible in the basin.

c) Significant flood control benefits do exist within the Grand River basin with construction of select reservoirs.

The Comprehensive Water Resources Study, in its final form, considered two alternative plans to implement its basin recommendations. Plan A suggested that when storage in certain reservoirs would be proportioned among multiple-use purposes, such as flood control, water quality, water supply, recreation, and fish and wildlife, more favorable economic conditions would emerge and a favorable cost-benefit ratio would be feasible. Plan B was written as a result of public reaction to Plan A and took into consideration such public sentiments as ownership of land on which reservoirs would be constructed, fear of influx of urban recreationists, reduction of local tax base with properties transferred from private to public ownership, and ecological effects of reservoir construction. Plan B, therefore, provides for a minimum of structural flood protection works and depends mostly on nonstructural measures such as flood forecasting, flood plain regulation, floodproofing, and permanent evacuation of flood plains. One of three reservoirs considered in Plan B would be used for flood control and two would be multiple-purpose projects providing recreation or fish and wildlife benefits in addition to flood prevention.



PROFILES
GRAND RIVER BASIN

1980

FERC-WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING

FIGURE 1

KEY TO NUMBERS

1. WEBBER
2. PORTLAND
3. NORTH LANSING
4. MOORES PARK
5. SMITHVILLE
6. IRVING
7. EATON RAPIDS
8. CHILDSDALE
9. ROCKFORD
10. ADA
11. CASCADE
12. LA BARGE
13. MIDDLEVILLE
14. KING MILL
15. LOWELL NO. 1
16. SMYRNA
17. BELDING
18. GREENVILLE
19. SARANAC MILLPOND
20. HUBBARDSTON
21. ELSIE
22. LYONS
23. WACOUSTA
24. WILLIAMSTON
25. DIMONDALE
26. JACKSON
27. MICHIGAN CENTER
28. LIBERTY MILLS
29. ISLAND (STEAM)
30. ECKERT STA. (STEAM)
31. ERICKSON (STEAM)
32. OTTAWA (STEAM)
33. GRAND RAPIDS
34. SARANAC
35. PORTLAND
36. MC GEE
37. DANBY
38. ONONDAGA
39. OKEMOS
40. WILLIAMSTON
41. LA BARGE
42. PRAIRIE CREEK
43. PORTLAND

LEGEND

STATUS	RESERVOIR	POWERPLANT HYDRO	POWERPLANT STEAM
EXISTING AND UNDER CONSTRUCTION		■	●
POTENTIAL		▨	

BASIN MAP
GRAND RIVER BASIN

0 10 20 MILES

1980

FERC-WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING

FIGURE 2

POTENTIAL WATER RESOURCE DEVELOPMENTS

From among the 211 possible sites inventoried by the Corps of Engineers and Soil Conservation Service, 6 sites with flood prevention capabilities were considered to be economically and environmentally acceptable. Table 5 shows the pertinent data for these six reservoirs.

Table 5

Potential Multiple-Purpose Reservoirs
Grand River Basin

Map No.	Site Name	River	Drainage Area (sq mi)	Flood Control Storage Capacity (ac-ft)	Total Storage Capacity (ac-ft)
38	Onondaga	Grand	569	30,000	221,300
39	Okemos	Red Cedar	306	10,000	23,800
40	Williamston	Red Cedar	228	20,000	67,200
41	LaBarge	Thornapple	798	80,000	115,000
42	Prairie Creek	Prairie Creek	100	10,000	61,900
43	Portland	Looking Glass	312	20,000	36,700

Projected Thermal Generating Capacity and Cooling Needs

Table 6 lists the projected thermal generating capacity and cooling water needs in the Grand River basin. These data are based on information compiled for the Water Resources Council's Second National Water Assessment and information reported to the Department of Energy - Economic Regulation Administration by the East Central Area Reliability Council (ECAR).

Table 6

Projected Steam-Electric Generation
Grand River Basin

Year	Capacity (kW)	Generation (kWh)	Cooling Water Use	
			Withdrawn (mgd)	Consumed (mgd)
1985	546,000	1,828	121	2
2000	1,304,000	3,977	39	6

The large increase in capacity between the years 1985 and 2000 is due to assumed future plant construction. The dramatic decrease of cooling water withdrawals can be attributed to reduction of plant capacities utilizing once-through cooling systems and an increase in capacity of plants utilizing closed cooling systems with cooling towers.

* U.S. GOVERNMENT PRINTING OFFICE: 1980- 333-723/6917